

U.S. DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE		DATE: November 16, 2001
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPL. NO. (if known): 09/926540
INTERNATIONAL APPLICATION NO.: PCT/JP/00/03172	INTERNATIONAL FILING DATE: MAY 17, 2000	PRIORITY DATE CLAIMED: MAY 18, 1999
TITLE OF INVENTION: SEALING BUSH FOR TUBE INSERTED THROUGH PARTITION AND MULTI-FLASH EVAPORATOR INCORPORATING SAME		
APPLICANT(S) FOR DO/EO/US: Teizo HIRAO, Kazuhiro IMABAYASHI, Masaki TANIGUCHI, Kouzi TAKANABE and Hiroyuki OTSUKA		
Applicant hereby submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<p>1. <u>XX</u> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <u> </u> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <u>XX</u> This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <u>XX</u> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <u>XX</u> A copy of the International Application as filed (35 U.S.C. 371(c)(2)):</p> <p style="margin-left: 20px;">a. <u> </u> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p style="margin-left: 20px;">b. <u>XX</u> has been transmitted by the International Bureau.</p> <p style="margin-left: 20px;">c. <u> </u> is not required, as the application was filed in the United States Receiving Office (RO/US)</p> <p>6. <u>XX</u> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <u>XX</u> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p style="margin-left: 20px;">a. <u> </u> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p style="margin-left: 20px;">b. <u> </u> have been transmitted by the International Bureau.</p> <p style="margin-left: 20px;">c. <u> </u> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p style="margin-left: 20px;">d. <u>XX</u> have not been made and will not be made.</p> <p>8. <u> </u> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <u> </u> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <u>XX</u> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>ITEMS 11. TO 16. BELOW CONCERN OTHER DOCUMENT(S) OR INFORMATION INCLUDED:</p> <p>11. <u> </u> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <u> </u> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. ASSIGNEE NAME AND ADDRESS: HITACHI ZOSEN CORPORATION, Osaka-shi, Japan Please publish the assignee data with the application.</p> <p>13. <u>XX</u> A FIRST preliminary amendment. <u> </u> A SECOND or SUBSEQUENT preliminary amendment</p> <p>14. <u> </u> A substitute specification.</p> <p>15. <u> </u> A change of power of attorney and/or address letter.</p> <p>16. <u>XX</u> Other items or information: Submission of Substitute Pages and 9 sheets of drawings.</p>		

U.S. APPLICATION NO. (if known) 09/926540	INTERNATIONAL APPLICATION NO. PCT/JP/00/03172	DATE: November 16, 2001
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17. <input checked="" type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO: \$890.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$710.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$740.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1040.00 International preliminary examination fee (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00 <div style="text-align: right;">ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 890.00</div>	<u>CALCULATIONS</u>	<u>PTO USE ONLY</u>
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Surcharge of \$130.00 for furnishing the oath or declaration later than __ 20 x 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	\$ 130.00	
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CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
TOTAL	2 -20 =		X \$ 18.00		
INDEPENDENT	1 - 3 =		X \$ 84.00		
Multiple dependent claims(s) (if applicable)			+ \$280.00		
TOTAL OF ABOVE CALCULATIONS =				\$1,020.00	
Reduction by 1/2 for filing by small entity, if applicable. (Note 37 CFR 1.9, 1.27, 1.28).					
SUBTOTAL =				\$1,020.00	
Processing fee of \$130.00 for furnishing the English translation later than __ 20 __ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +					
TOTAL NATIONAL FEE =				\$1,020.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <div style="text-align: right;">\$40.00 per property +</div>					
TOTAL FEES ENCLOSED =				\$1,020.00	
				Amount to be: <div style="text-align: right;">_____ refunded \$ _____</div> <div style="text-align: right;">_____ charged \$ _____</div>	

U.S. APPLICATION NO. (if known) 09/926540	INTERNATIONAL APPLICATION NO. PCT/JP/00/03172	DATE: November 16, 2001
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- a. ☒ A check in the amount of \$ 1,020.00 to cover the above fees is enclosed. (\$890.00 for basic filing fee and \$130.00 for late filing of the declaration). (This paper is filed in triplicate)
- b. ☐ Please charge my Deposit Account No. 01-2340 in the amount of \$___ to cover the above fees. (A duplicate copy of this sheet is enclosed.)
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 01-2340.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed to request that the application be restored to pending status.

Send All Correspondence To:



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PATENT TRADEMARK OFFICE


SIGNATURE

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MRQ/yap

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09/926540

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: **Teizo HIRAO et al.**

Serial Number: **Not Yet Assigned**

(§ 371 of International Application No.: PCT/JP00/03172)

Filed: **November 16, 2001**

For: **SEALING BUSH FOR TUBE INSERTED THROUGH PARTITION AND MULTI-FLASH EVAPORATOR INCORPORATING SAME**

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

November 16, 2001

Sir:

Prior to the calculation of the filing fees of the above application, please amend the application as follows:

IN THE CLAIMS:

Please cancel claims 3-7 without prejudice or disclaimer and amend claims 1 and 2 as follows:

1. (Amended) A sealing bush for a tube inserted through a hole formed in a partition for sealing a clearance in the hole around the tube, for use in a multi-flash evaporator comprising a multiplicity of housings elongated from front rearward and arranged side by side from left rightward, the housings having a pressure successively reducing from housing to housing from the left rightward, a bundle of condensation tubes provided in a widthwise central portion of each of the housings at an upper part thereof and extending longitudinally of the housing, a gutterlike condensate receptacle disposed below the tube bundle for receiving a condensate from the tube bundle, an

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REMARKS

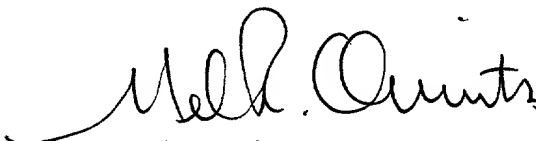
The above amendment is submitted to place the claims in substantially the same condition as to the claims which have been amended under Article 34 in the international application. An English translation of the annexes of the PCT international preliminary examination report is enclosed. Early and favorable action is awaited.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

In the event there are any additional fees required, please charge our Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, WESTERMAN, HATTORI,
McLELAND & NAUGHTON, LLP



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claims 1 and 2 have been amended as follows:

1. (Amended) A sealing bush for a tube inserted through a hole formed in a partition for sealing a clearance in the hole around the tube, for use in a multi-flash evaporator comprising a multiplicity of housings elongated from front rearward and arranged side by side from left rightward, the housing having a pressure successively reducing from housing to housing from the left rightward, a bundle of condensation tubes provided in a widthwise central portion of each of the housings at an upper part thereof and extending longitudinally of the housing, a gutterlike condensate receptacle disposed below the tube bundle for receiving a condensate from the tube bundle, an evaporation chamber central partition positioned between a widthwise midportion of a bottom wall of the condensate receptacle and a widthwise midportion of a bottom wall of the housing and extending longitudinally of the housing for forming left and right evaporation stages in a lower portion of the housing, a condensation chamber central partition disposed at a lengthwise midportion of the tube bundle and having the condensation tubes inserted therethrough, a condensation chamber left front-half partition extending from an upper edge of a left side wall of the condensate receptacle to a widthwise midportion of a top wall of the housing around a front half of the tube bundle and covering an outer periphery of the front half of the tube bundle at a left side thereof for permitting vapor produced in the left evaporation stage to flow into the tube bundle only at a rear half thereof, and a condensation chamber right rear-half partition extending from an upper edge of a right side wall of the condensate receptacle to the widthwise midportion of the top wall of the housing around the rear half of the tube bundle and covering an outer periphery of the rear half of the tube bundle at a right side thereof for permitting vapor produced in the right evaporation stage to flow in the tube

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bundle only at the front half thereof, so that sea water admitted into the housing at the left end is caused to flow into all the other housings successively through orifices and flashed for desalination, wherein the condensation chamber central partition being formed with holes having a diameter greater than the outside diameter of the condensation tubes, characterized in the sealing bush comprising a cylindrical body having an inner periphery with a diameter greater than the outside diameter of the tube, an outer periphery with a diameter smaller than the diameter of the hole and a front-to-rear length greater than the depth of the hole, an inner seal portion formed on the inner periphery of the body and fittable around the tube in intimate contact therewith, an outer seal portion formed on the outer periphery of the body and fittable to an inner peripheral surface of the partition defining the hole in intimate contact with the surface, an engaging portion formed on the outer periphery of the body at a front end thereof and projecting radially outwardly of the body for preventing the bush from reversely slipping out of the hole, the engaging portion being forcibly movable through the hole and engageable with a front edge of the hole-defining inner peripheral surface of the partition after being moved through the hole, and a retaining portion formed on the outer periphery of the body at a rear end thereof and projecting radially outwardly of the body, the retaining portion being movable into contact with a rear edge of the hole-defining inner peripheral surface of the partition after the engaging portion is forcibly moved through the hole to prevent the bush from moving through the hole, the engaging portion is shaped in the form of a rectangular triangle having a small angle at a front end thereof in longitudinal section, the retaining portion is shaped in the form of a rectangular triangle having a small angle at a rear end thereof in longitudinal section, and the front end of the body is formed with a plurality of slits extending longitudinally thereof for permitting the engaging portion to move through the hole easily.

2. (Amended) A sealing bush for a tube inserted through a partition for use in a multi-flash

evaporator according to claim 1 wherein the front end of the body is formed with slits extending longitudinally thereof for permitting the engaging portion to move through the hole easily which is made of a nonmetallic material.

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SPECIFICATION

SEALING BUSH FOR TUBE INSERTED THROUGH PARTITIONFOR USE IN MULTI-FLASH EVAPORATOR

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TECHNICAL FIELD

- 5 The present invention relates to sealing bushes for tubes inserted through partitions for use in multi-flash evaporators.

BACKGROUND ART

- Multi-flash evaporators are already known which
- 10 comprising a multiplicity of housings elongated from front rearward and arranged side by side from left rightward, the housings having a pressure successively reducing from housing to housing from the left rightward, a bundle of condensation tubes provided in a
- 15 widthwise central portion of each of the housings at an upper part thereof and extending longitudinally of the housing, a gutterlike condensate receptacle disposed below the tube bundle for receiving a condensate from the tube bundle, an evaporation chamber central
- 20 partition positioned between a widthwise midportion of a bottom wall of the condensate receptacle and a widthwise midportion of a bottom wall of the housing and extending

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ART 34 AMDT

longitudinally of the housing for forming left and right
evaporation stages in a lower portion of the housing, a
condensation chamber central partition disposed at a
lengthwise midportion of the tube bundle and having the
5 condensation tubes inserted therethrough, a condensation
chamber left front-half partition extending from an
upper edge of a left side wall of the condensate
receptacle to a widthwise midportion of a top wall of
the housing around a front half of the tube bundle and
10 covering an outer periphery of the front half of the
tube bundle at a left side thereof for permitting vapor
produced in the left evaporation stage to flow into the
tube bundle only at a rear half thereof, and a
condensation chamber right rear-half partition extending
15 from an upper edge of a right side wall of the
condensate receptacle to the widthwise midportion of the
top wall of the housing around the rear half of the tube
bundle and covering an outer periphery of the rear half
of the tube bundle at a right side thereof for
20 permitting vapor produced in the right evaporation stage
to flow into the tube bundle only at the front half
thereof, so that sea water admitted into the housing at
the left end is caused to flow into all the other
housings successively through orifices and flashed for

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desalination. With the multi-flash evaporator described,
a clearance in each of the holes in the partition around
the condensation tube inserted therethrough is
conventionally sealed off by forming an annular groove

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of larger diameter than the hole in an edge portion of the partition defining the hole, fitting a metal ring into the annular groove and forcibly inserting the condensation tube through the ring.

- 5 The conventional seal thus formed has the problem of necessitating much time and labor for forming the annular groove and the problem of corrosion of the metal ring used. Another problem is also encountered in that the ring will slip off or will remain fixed to the
- 10 condensation tube when the tube is to be replaced.

- An object of the present invention is to provide a bush, for use in a multi-flash evaporator, for sealing a clearance in a through hole in a partition around a tube inserted through the hole, by which the clearance can be
- 15 sealed off with reduced time and labor less costly without the likelihood of corrosion while rendering the tube replaceable easily without permitting the bush to slip off or to become fixed to the tube.

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DISCLOSURE OF THE INVENTION

The present invention provides a sealing bush for a tube inserted through a hole formed in a partition for sealing a clearance in the hole around the tube for use

5 in a multi-flash evaporator, the multi-flash evaporator comprising a multiplicity of housings elongated from front rearward and arranged side by side from left rightward, the housings having a pressure successively reducing from housing to housing from the left

10 rightward, a bundle of condensation tubes provided in a widthwise central portion of each of the housings at an upper part thereof and extending longitudinally of the housing, a gutterlike condensate receptacle disposed below the tube bundle for receiving a condensate from

15 the tube bundle, an evaporation chamber central partition positioned between a widthwise midportion of a bottom wall of the condensate receptacle and a widthwise midportion of a bottom wall of the housing and extending longitudinally of the housing for forming left and right

20 evaporation stages in a lower portion of the housing, a condensation chamber central partition disposed at a lengthwise midportion of the tube bundle and having the condensation tubes inserted therethrough, a condensation chamber left front-half partition extending from an

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upper edge of a left side wall of the condensate
receptacle to a widthwise midportion of a top wall of
the housing around a front half of the tube bundle and
covering an outer periphery of the front half of the
5 tube bundle at a left side thereof for permitting vapor
produced in the left evaporation stage to flow into the
tube bundle only at a rear half thereof, and a
condensation chamber right rear-half partition extending
from an upper edge of a right side wall of the
10 condensate receptacle to the widthwise midportion of the
top wall of the housing around the rear half of the tube
bundle and covering an outer periphery of the rear half
of the tube bundle at a right side thereof for
permitting vapor produced in the right evaporation stage
15 to flow into the tube bundle only at the front half
thereof, so that sea water admitted into the housing at
the left end is caused to flow into all the other
 housings successively through orifices and flashed for
desalination, the condensation chamber central partition
20 being formed with holes having a diameter greater than
the outside diameter of the condensation tubes,
characterized in the sealing bush comprising a
cylindrical body having an inner periphery with a
diameter greater than the outside diameter of the tube,

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an outer periphery with a diameter smaller than the diameter of the hole and a front-to-rear length greater than the depth of the hole, an inner seal portion formed on the inner periphery of the body and fittable around the tube in intimate contact therewith, an outer seal portion formed on the outer periphery of the body and fittable to an inner peripheral surface of the partition defining the hole in intimate contact with the surface, an engaging portion formed on the outer periphery of the body at a front end thereof and projecting radially outwardly of the body for preventing the bush from reversely slipping out of the hole, the engaging portion being forcibly movable through the hole and engageable with a front edge of the hole-defining inner peripheral surface of the partition after being moved through the hole, and a retaining portion formed on the outer periphery of the body at a rear end thereof and projecting radially outwardly of

the body, the retaining portion being movable into contact with a rear edge of the hole-defining inner peripheral surface of the partition after the engaging portion is forcibly moved through the hole to prevent

5 the bush from moving through the hole, the engaging portion being shaped in the form of a rectangular triangle having a small angle at a front end thereof in longitudinal section, the retaining portion being shaped in the form of a rectangular triangle having a small

10 angle at a rear end thereof in longitudinal section, and the front end of the body being formed with a plurality of slits extending longitudinally thereof for permitting the engaging portion to move through the hole easily.

When fitted into the hole formed in the partition,

15 the sealing bush of the invention is fixed in position. When the tube is then merely inserted through the bush, a clearance in the hole of the partition around the tube inserted through the hole can be sealed. The bush therefore eliminates the need for the time-consuming

20 costly procedure of making the annular groove, ensuring a sealing effect by the inner seal portion and the outer seal portion. The engaging portion and the retaining portion further prevent the bush from slipping off the partition or becoming fixed to the tube, consequently

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assuring facilitated replacement of the tube.

Preferably, the engaging portion is shaped in the form of a rectangular triangle having a small angle at a front end thereof in longitudinal section.

5 Further preferably, the bush is made of a

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nonmetallic material such as Teflon. Teflon (PTFE) has corrosion resistance over a wide temperature range, overcoming the problem of corrosion to be encountered with the use of the metal ring.

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Since the multi-flash evaporator for desalinating sea water has the likelihood of corrosion with vapor, metal seals are not suited to use in the evaporator, while the chambers separated by a partition are small in pressure difference therebetween, and the internal pressure of the chambers is as low as up to 1 atom. Accordingly the sealing bush described above is suitable for use in the multi-flash evaporator for the tubes inserted through the partition.

10 BRIEF DESCRIPTION OF THE DRAWINGS

- ✓ FIG. 1 is a fragmentary perspective view showing a multi-flash evaporator provided with sealing bushes of the invention for tubes inserted through a partition.
- ✓ FIG. 2 is an enlarged view in cross section showing the front half of the evaporator of FIG. 1.
- 15 ✓ FIG. 3 is an enlarged view in cross section of the rear half of the same.
- ✓ FIG. 4 is a perspective view showing a first embodiment of sealing bush of the invention for the partition-inserted tube.
- 20 ✓ FIG. 5 is a view in longitudinal section of the same.

✓ FIG. 6 is an enlarged view in longitudinal section of the same.

✓ FIG. 7 is a perspective view showing a second embodiment of sealing bush of the invention for the
5 partition-inserted tube.

✓ FIG. 8 is a view in longitudinal section of the same.

✓ FIG. 9 is an enlarged view in longitudinal section of the same.

10 ✓ FIG. 10 is a perspective view showing a third embodiment of sealing bush of the invention for the partition-inserted tube.

✓ FIG. 11 is a view in longitudinal section of the same.

15 ✓ FIG. 12 is an enlarged view in longitudinal section of the same.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiments of the invention will be described below with reference to the drawings.

20 The terms "front," "rear," "left" and "right" used herein are based on FIG. 2; the term "front" refers to the front side of the plane of the drawing, the term "rear" to the rear side thereof, and the terms "left"

and "right" refer respectively to the left-hand side and right-hand side of the drawing. These terms are used for the sake of convenience, and the illustrated device may be used as positioned in reverse relation to the illustration with respect to the longitudinal or lateral direction.

FIGS. 1 to 3 show part of a multi-flash evaporator which is desirable for use with sealing bushes of the invention for the tubes extending through a partition.

10 The illustrated multi-flash evaporator is adapted for use in the desalination of sea water and has a large number of housings 1 which are elongated in the front-to-rear direction and arranged side by side from the left rightward. Each housing 1 has a lower portion
15 serving as an evaporation chamber 2, and an upper portion as a condensation chamber 3.

The evaporation chamber 2 is divided into a left (high-temperature) evaporation stage 2a and a right (low-temperature) evaporation stage 2b by an evaporation
20 chamber central partition 4 extending longitudinally of the housing and positioned between the widthwise midportion of bottom wall 6c of a condensate receptacle 6 and the widthwise midportion of bottom wall 1c of the housing 1. A multiplicity of orifices 10 for causing

sea water (heated brine) to flow in therethrough are formed in each of the lower edge portion of left side wall 1a of the housing 1 and the lower edge portion of the central partition 4. Although not shown, the housing 1 at the right end is connected to a vacuum pump for suction. The sea water introduced into the housing 1 at the left end is caused to flow downstream through the orifices 10, whereby the evaporation stages 2a, 2b of each housing 1 are maintained at a pressure reducing by a small decrement (corresponding to a temperature decrement of 2° C) as the water flows from the left rightward.

Provided downstream from the orifices 10 is an underwater barrier 13 having a horizontal wall 14 at its upper end. Disposed horizontally above the barrier 13 is a baffle 15 for preventing a splash of the brine. The sea water flowing into the housing 1 passes over the underwater barrier 13, whereby the vaporization thereof is promoted, while drops of bumping water are prevented from ingressing into the condensation chamber 3 by the baffle 15.

The condensation chamber 3 is provided with a bundle of condensation tubes which is circular in vertical section and extends longitudinally of the housing 1 at

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an upper part of widthwise central portion thereof.
Disposed below the tube bundle 5 is a gutterlike
condensate receptacle 6 for receiving the liquid
produced by condensation on the outer peripheral
5 surfaces of the condensation tubes 5a. A demister
(mesh) 8 for catching water droplets entrained in vapor
is provided horizontally between the upper end of left
side wall 6a of the condensate receptacle 6 and the left
side wall 1a of the housing 1 and between the upper edge
10 of right side wall 6b of the receptacle 6 and the right
side wall 1b of the housing 1.

With reference to FIGS. 2 and 3, the condensation
chamber 3 is divided by a central partition 7 positioned
at the lengthwise midportion of the tube bundle 5 and
15 having the condensation tube 5a inserted therethrough, a
left front-half partition 11 extending from the upper
edge of left side wall 6a of the receptacle 6 to the
widthwise midportion of top wall 1d of the housing
around the front half of the tube bundle 5 and in the
20 form of a circular-arc (corresponding to a quarter of
the circumference) in cross section to cover the outer
periphery of front half of the tube bundle 5 at the left
side thereof, and a right rear-half partition 12
extending from the upper edge of right side wall 6b of

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the receptacle 6 to the widthwise midportion of top wall 1d of the housing around the rear half of the tube bundle 5 and in the form of a circular-arc, similar to the above, in cross section to cover the outer periphery of rear half of the tube bundle 5 at the right side thereof. The provision of these three partitions 7, 11, 12 permits the vapor produced in the left evaporation stage 2a to flow into the tube bundle 5 only at the rear half thereof, and the vapor produced in the right evaporation stage 2b to flow only into the front half of the tube bundle 5.

The condensation chamber 3 is further provided with a vertical central baffle plate 16 extending through the center of interior upper portion of the tube bundle 5 over the entire length thereof, a horizontal left front-half baffle plate 17 provided in the front-half of interior portion of the tube bundle 5 at the left of its center, and a horizontal right rear-half baffle plate 18 provided in the rear-half of interior portion of the tube bundle 5 at the right of its center. The vertical central baffle plate 16 has an upper edge joined to the housing top wall 1d, the horizontal left front-half baffle plate 17 has a left edge joined to the upper edge of the receptacle left side wall 6a, and the horizontal

right rear-half baffle plate 18 has a right edge joined to the upper edge of the receptacle right side wall 6b. The left front-half partition 11 is held between the portion of the central baffle plate 16 close to its upper edge and the portion of the left front-half baffle plate 17 close to its left edge. The right rear-half partition 12 is held between the portion of the central baffle plate 16 close to its upper edge and the portion of the right rear-half baffle plate 18 close to its right edge.

With the multi-flash evaporator described, sea water is admitted into all the housings 1 successively through the orifices 10, whereby the sea water flowing in over the underwater barriers 13 into the respective evaporation stages 2a, 2b of each housing 1 is allowed to flash. The resulting water vapor having fine salt-containing water droplets entrained therein passes through the demister 8 and is separated from the fine water droplets in the meantime. The water vapor in the left evaporation stage 2a flows into the condensation tube bundle 5 at its rear half and is thereby converted into a water condensate on cooling, while the water vapor in the right evaporation stage 2b flows into the front half of the tube bundle 5 and is thereby condensed

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to water on cooling.

With the multi-flash evaporator, a clearance in each of through holes 7a formed in the central partition 7 of the condensation chamber, around the condensation tube

5 5a inserted through the hole is sealed with a bush 20, 30 or 40 of Teflon (PTFE) as will be described in detail below.

FIGS. 4 to 6 show a first embodiment of sealing bush for the tube extending through the partition. As shown
10 in these drawings, the sealing bush 20 of the first embodiment comprises a cylindrical body 21, inner seal portions 22 formed on the inner peripheral surface of the body 21 respectively at opposite sides of the lengthwise midportion thereof and fittable around the
15 condensation tube 5a in intimate contact therewith, an outer seal portion 23 formed on the outer peripheral surface of the body 21 at the lengthwise midportion thereof and fittable to the inner peripheral surface of the partition 7 defining the through hole 7a in intimate
20 contact therewith, an engaging portion 24 formed on the outer peripheral surface of the body 21 at its front end and projecting radially outwardly of the body for preventing the bush from reversely slipping out of the hole 7a, the engaging portion 24 being forcibly movable

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through the through hole 7a and engageable with the front edge of the hole-defining inner peripheral surface of the partition 7 after being moved through the hole, and a retaining portion 25 formed on the outer
5 peripheral surface of the body 21 at its rear end and projecting radially outwardly of the body for preventing the bush from moving through the hole.

The cylindrical body 21 has an inner periphery with a diameter greater than the outside diameter of the
10 condensation tube 5a, an outer periphery smaller than the diameter of the through hole 7a and an axial length (front-to-rear length) greater than the depth (front-to-rear length) of the hole 7a.

The inner seal portions 22 and the outer seal
15 portion 23 are each annular, and rectangular in longitudinal section and each have a length about 1/10 of the overall length of the body 21. The inner seal portions 22 have an inside diameter slightly smaller than the outside diameter of the condensation tube 5a.
20 The outer seal portion 23 has an outside diameter slightly greater than the inside diameter of the through hole 7a. The seal portions 22, 23 elastically deform to come into intimate contact respectively with the outer peripheral surface of the condensation tube 5a and the

0926640-031502

partition inner peripheral surface defining the through hole 7a for reliable sealing.

In longitudinal section, the engaging portion 24 is in the form of a rectangular triangle having a small angle at its front end. The front end of the body 21 where the engaging portion 24 is formed has eight slits 26 extending longitudinally of the body and circumferentially spaced apart at a predetermined distance for permitting the engaging portion 24 to pass through the hole 7a easily.

In longitudinal section, the retaining portion 25 is in the form of a rectangular triangle having a small angle at its rear end. The rear end of the body 21 where the retaining portion 25 is formed has no slit but may of course be formed with longitudinal slits.

The distance between the rear end face of the engaging portion 24 and the front end face of the retaining portion 25 is approximately equal to the depth of the through hole 7a, with the result that when the engaging portion 24 is forcibly passed through the hole 7a, the engaging portion 24 comes into engagement with the front edge of the hole-defining inner peripheral surface of the partition 7 to prevent the bush 20 from slipping out of the hole rearward, while the retaining

portion 25 comes into contact with the rear edge of the hole-defining inner peripheral surface, preventing the bush 20 from forwardly slipping out of the hole 7a.

When the sealing bush 20 is forcibly fitted into the hole 7a of the partition 7, the engaging portion 24 is diametrically diminished owing to the presence of the slits 26, with the outer seal portion 23 elastically deformed, so that the bush 20 can be fitted in easily. The bush 20 as fitted in is prevented from moving longitudinally thereof by the engaging portion 24 and the retaining portion 25, while the outer seal portion 23 effectively seals off the joint between the bush 20 and the partition 7. When the condensation tube 5a is thereafter inserted through the bush 20, the inner seal portions 22 elastically deform, facilitating the insertion of the tube 5a and effectively sealing off the joint between the bush 20 and the tube 5a to hold the tube 5a to the partition 7 fluid-tightly.

FIGS. 7 to 9 show a second embodiment of sealing bush for the tube inserted through the partition. As shown in these drawings, the sealing bush 30 of the second embodiment comprises a cylindrical body 31, an inner seal portion 32 formed on the inner peripheral surface of the body 31 and fittable around the

09926540-031502

condensation tube 5a in intimate contact therewith, an outer seal portion 33 formed on the outer peripheral surface of the body 31 and fittable to the inner peripheral surface of the partition 7 defining the

5 through hole 7a in intimate contact therewith, an engaging portion 34 formed on the outer peripheral surface of the body 31 at its front end and projecting radially outwardly of the body for preventing the bush 30 from reversely slipping out of the hole 7a, the

10 engaging portion 34 being forcibly movable through the through hole 7a and engageable with the front edge of the hole-defining inner peripheral surface of the partition 7 after being moved through the hole 7a, and a retaining portion 35 formed on the outer peripheral

15 surface of the body 31 at its rear end and projecting radially outwardly of the body for preventing the bush 30 from moving through the hole. The body 31 is provided in its front end portion with eight longitudinal slits 36 for permitting the engaging

20 portion 34 to pass through the through hole 7a easily.

According to the present embodiment, the inner seal portion 32 and the outer seal portion 33 each have six teeth 32a or 33a and are saw-toothed in section. In section, the three of the teeth toward the front are

09926940-031502

each in the form of a rectangular triangle having a small angle at its front end, while the other three teeth toward the rear are each in the form of a rectangular triangle in section, with a small angle at its rear end. The teeth 32a of the inner seal portion 32 have an inside diameter slightly smaller than the outside diameter of the condensation tube 5a. The teeth 33a of the outer seal portion 33 have an outside diameter slightly greater than the inside diameter of the through hole 7a.

The second embodiment has the same shape as the first embodiment with respect to the body 31, engaging portion 34, retaining portion 35 and slits 36.

When the sealing bush 30 is forcibly fitted into the hole 7a of the partition 7, the engaging portion 34 is diametrically diminished owing to the presence of the slits 36, with the outer seal portion 33 elastically deformed, so that the bush 30 can be fitted in easily. The bush 30 as fitted in is prevented from moving longitudinally thereof by the engaging portion 34 and the retaining portion 35, while the outer seal portion 33 effectively seals off the joint between the bush 30 and the partition 7. When the condensation tube 5a is thereafter inserted through the bush 30, the inner seal

portion 32 elastically deforms, facilitating the insertion of the tube 5a and effectively sealing off the joint between the bush 30 and the tube 5a to hold the tube 5a to the partition 7 fluid-tightly. With the bush 30 of the second embodiment, the inner seal portion 32 and the outer seal portion 33 are both serrated in section, consequently rendering the bush 30 fittable into the through hole 7a with a reduced force and the bush 30 as fitted in the hole 7a difficult to remove therefrom. Furthermore, the condensation tube 5a can be inserted through the bush 30 with a smaller force, and the tube 5a as inserted through the bush 30 will not slip off easily.

FIGS. 10 to 12 show a third embodiment of sealing bush for the tube inserted through the partition. As shown in these drawings, the sealing bush 40 of the third embodiment comprises a cylindrical body 41, inner seal portions 42 formed on the inner peripheral surface of the body 41 and fittable around the condensation tube 5a in intimate contact therewith, an outer seal portion 43 formed on the outer peripheral surface of the body 41 and fittable to the inner peripheral surface of the partition 7 defining the through hole 7a in intimate contact therewith, an engaging portion 44 formed on the

movable through the through hole 7a and engageable with the front edge of the hole-defining inner peripheral surface of the partition 7 after being moved through the hole 7a, and a retaining portion 45 formed on the outer peripheral surface of the body 31 at its rear end and projecting radially outwardly of the body for preventing the bush 40 from moving through the hole. The body 41 is provided in its front end portion with eight longitudinal slits 46 for permitting the engaging portion 44 to pass through the through hole 7a easily.

The third embodiment has the same shape as the first

The third embodiment has the same shape as the first

Amended

ART 34 AMDT

22

embodiment with respect to the body 41, inner seal portions 42 and outer seal portion 43.

When the sealing bush 40 is forcibly fitted into the hole 7a of the partition 7, the engaging portion 44 is

5 diametrically diminished owing to the presence of the slits 46, with the outer seal portion 43 elastically deformed, so that the bush 40 can be fitted in easily. The bush 40 as fitted in is prevented from moving longitudinally thereof by the engaging portion 44 and

10 the retaining portion 45, while the outer seal portion 43 effectively seals off the joint between the bush 40 and the partition 7. When the condensation tube 5a is thereafter inserted through the bush 40, the inner seal portions 42 elastically deform, facilitating the

15 insertion of the tube 5a and effectively sealing off the joint between the bush 40 and the tube 5a to hold the tube 5a to the partition 7 fluid-tightly. With the bush 40 of the third embodiment, the engaging portion 44 comprises the projections 44a, consequently rendering

20 the bush 40 fittable into the through hole 7a with a reduced force.

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ART 34 AMDT

INDUSTRIAL APPLICABILITY

[illegible]

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24

ART 34 AMDT

CLAIMS

1. (Amended) A sealing bush for a tube inserted
through a hole formed in a partition for sealing a
clearance in the hole around the tube, for use in a
5 multi-flash evaporator comprising a multiplicity of
housings elongated from front rearward and arranged side
by side from left rightward, the housings having a
pressure successively reducing from housing to housing
from the left rightward, a bundle of condensation tubes
10 provided in a widthwise central portion of each of the
housings at an upper part thereof and extending
longitudinally of the housing, a gutterlike condensate
receptacle disposed below the tube bundle for receiving
a condensate from the tube bundle, an evaporation
15 chamber central partition positioned between a widthwise
midportion of a bottom wall of the condensate receptacle
and a widthwise midportion of a bottom wall of the
housing and extending longitudinally of the housing for
forming left and right evaporation stages in a lower
20 portion of the housing, a condensation chamber central
partition disposed at a lengthwise midportion of the
tube bundle and having the condensation tubes inserted
therethrough, a condensation chamber left front-half
partition extending from an upper edge of a left side

09926540-031502

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[illegible]

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26

PT 34 AMDT

smaller than the diameter of the hole and a front-to-rear length greater than the depth of the hole, an inner seal portion formed on the inner periphery of the body and fittable around the tube in intimate contact

5 therewith, an outer seal portion formed on the outer periphery of the body and fittable to an inner peripheral surface of the partition defining the hole in intimate contact with the surface, an engaging portion formed on the outer periphery of the body at a front end

10 thereof and projecting radially outwardly of the body for preventing the bush from reversely slipping out of the hole, the engaging portion being forcibly movable through the hole and engageable with a front edge of the hole-defining inner peripheral surface of the partition

15 after being moved through the hole, and a retaining portion formed on the outer periphery of the body at a rear end thereof and projecting radially outwardly of the body, the retaining portion being movable into contact with a rear edge of the hole-defining inner

20 peripheral surface of the partition after the engaging portion is forcibly moved through the hole to prevent the bush from moving through the hole, the engaging portion is shaped in the form of a rectangular triangle having a small angle at a front end thereof in

09926540-031502

Amended

27

ART 34 ARDT

longitudinal section, the retaining portion is shaped in
the form of a rectangular triangle having a small angle
at a rear end thereof in longitudinal section, and the
front end of the body is formed with a plurality of
5 slits extending longitudinally thereof for permitting
the engaging portion to move through the hole easily.

2. (Amended) A sealing bush for a tube inserted
through a partition for use in a multi-flash evaporator
according to claim 1 which is made of a nonmetallic
10 material.

3. (Canceled)

4. (Canceled)

5. (Canceled)

6. (Canceled)

15 7. (Canceled)

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ABSTRACT

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A sealing bush for a tube inserted through a hole in a partition is made of Teflon and comprises a cylindrical body 21 having an inner periphery with a diameter greater than the outside diameter of the tube 5a, an outer periphery with a diameter smaller than the diameter of the hole 7a and a front-to-rear length greater than the depth of the hole 7a, an inner seal portion 22 fittable around the tube 5a in intimate contact therewith, an outer seal portion 23 fittable to an inner peripheral surface of the partition defining the hole 7a in intimate contact with the surface, an engaging portion 24 forcibly movable through the hole 7a and engageable with a front edge of the hole-defining inner peripheral surface of the partition after being moved through the hole for preventing the bush from reversely slipping out of the hole, and a retaining portion 25 movable into contact with a rear edge of the hole-defining inner peripheral surface of the partition after the engaging portion 24 is forcibly moved through the hole 7a for preventing the bush from moving through the hole.

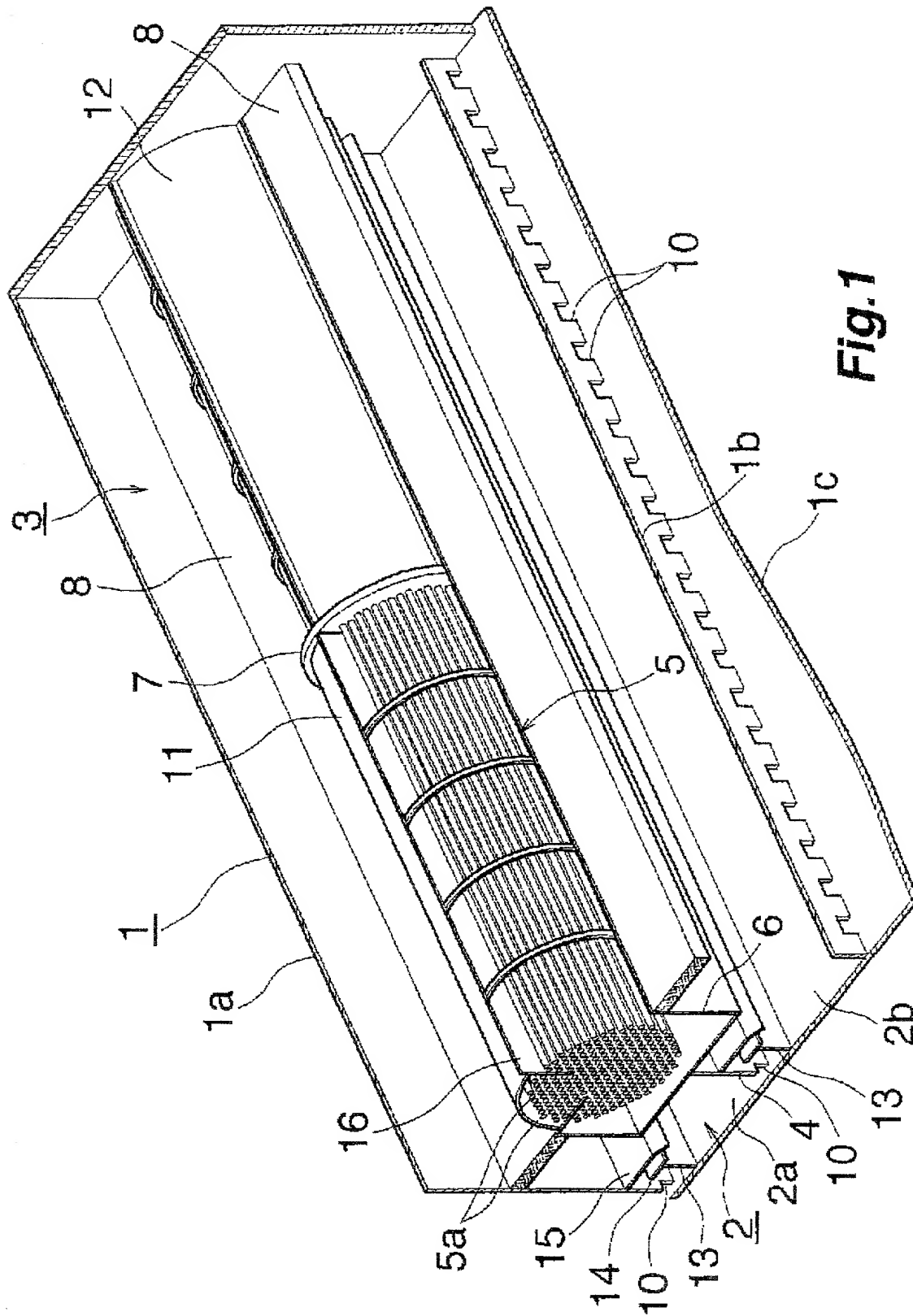


Fig. 1

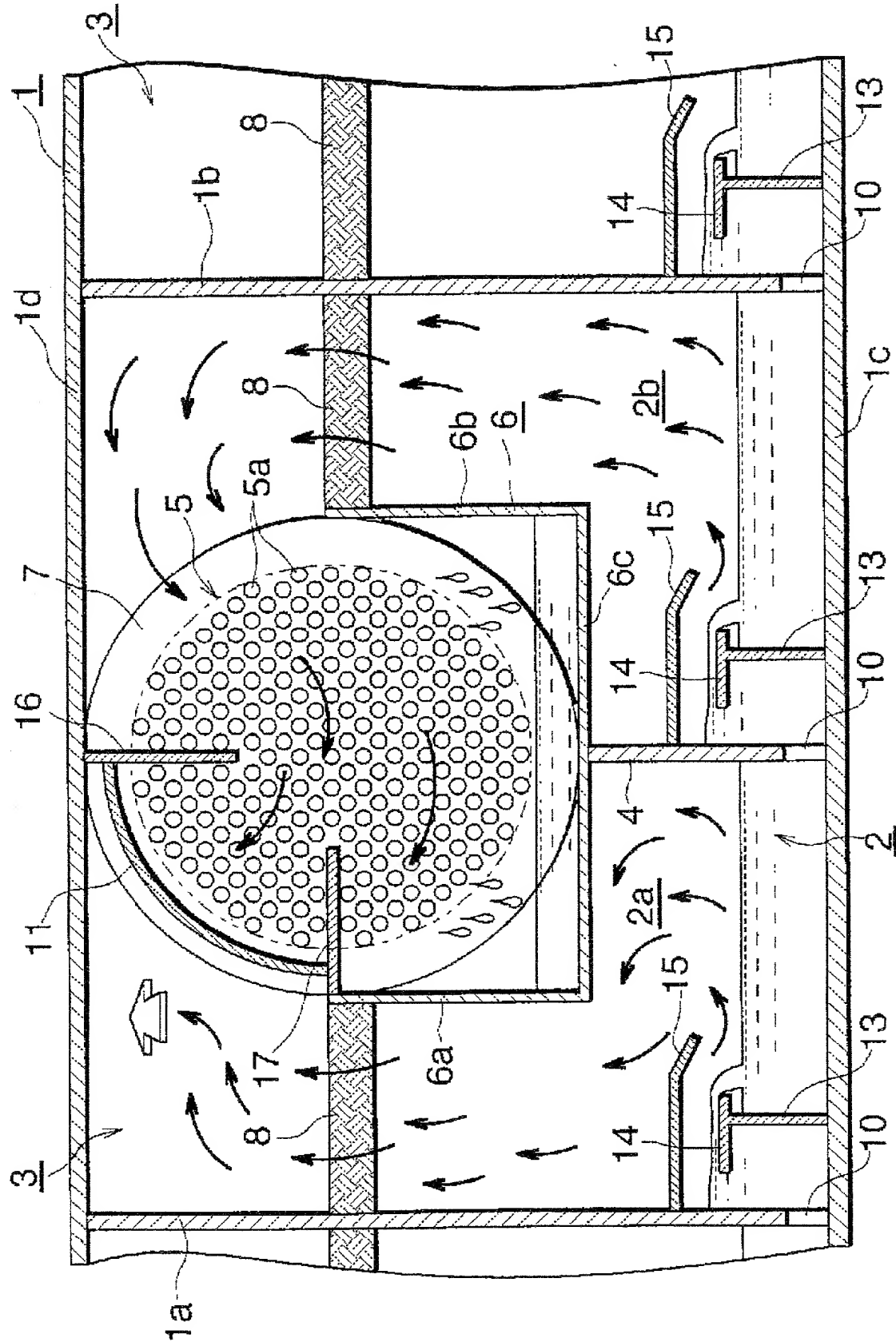


Fig. 2

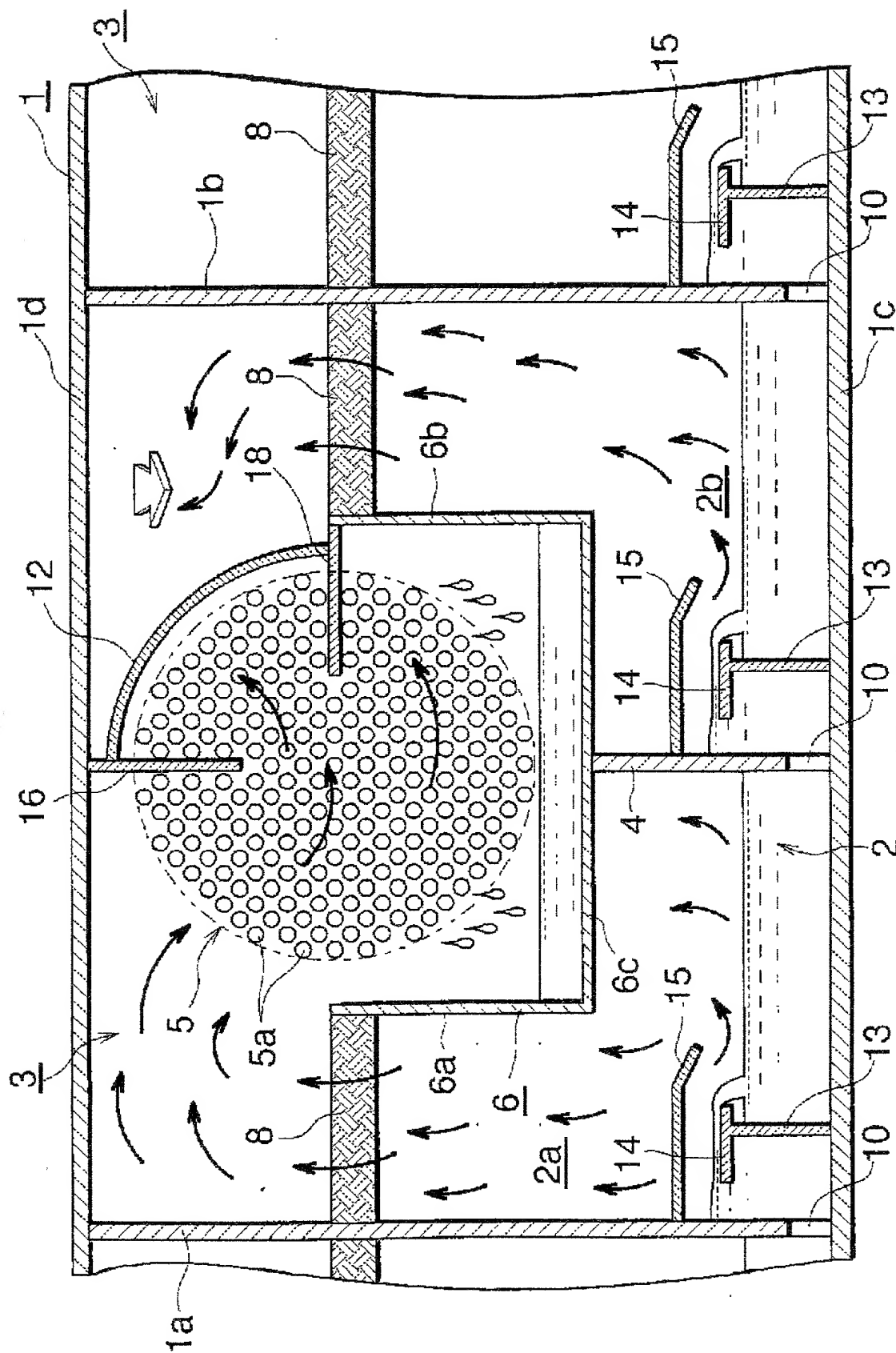
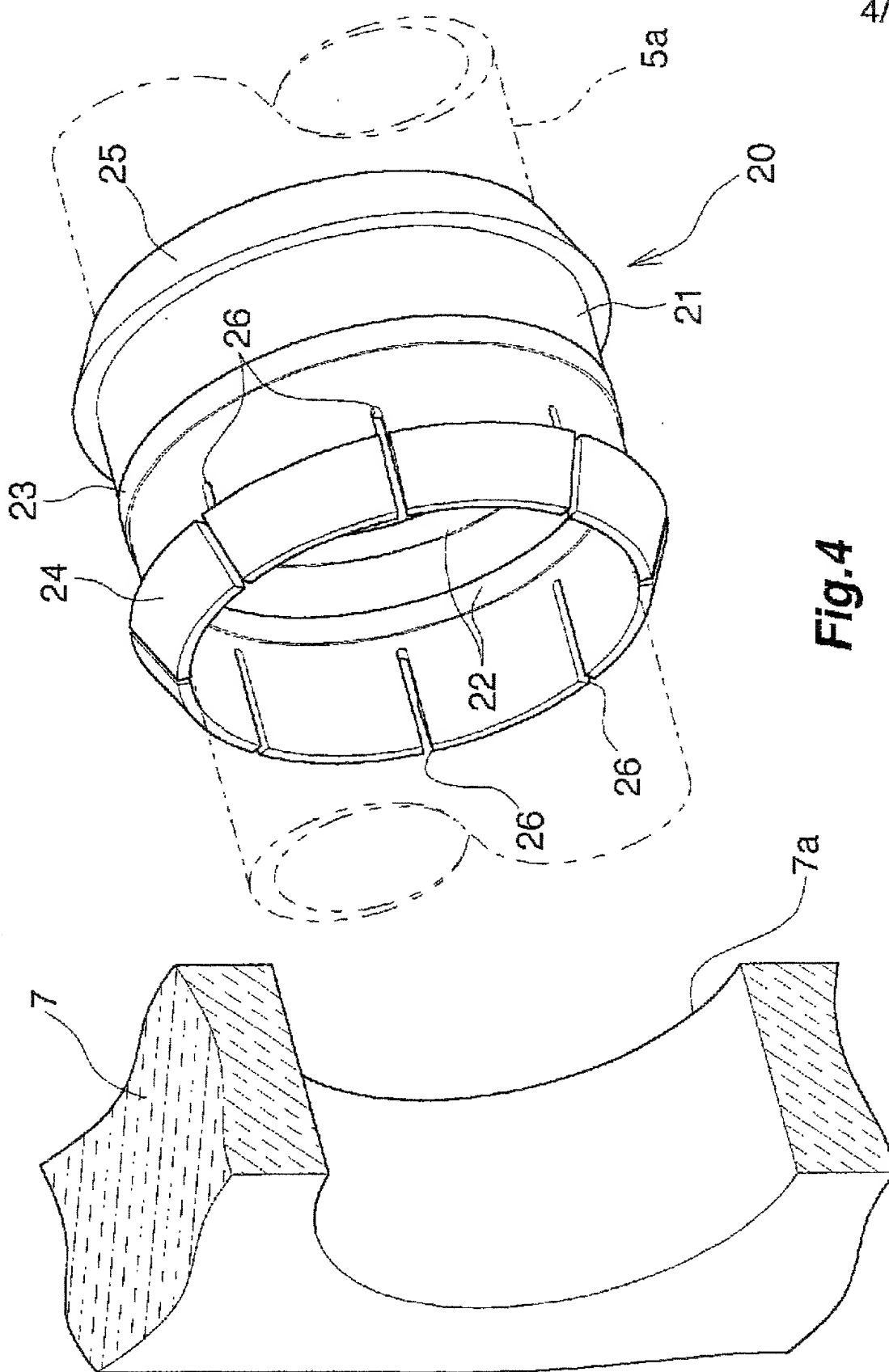
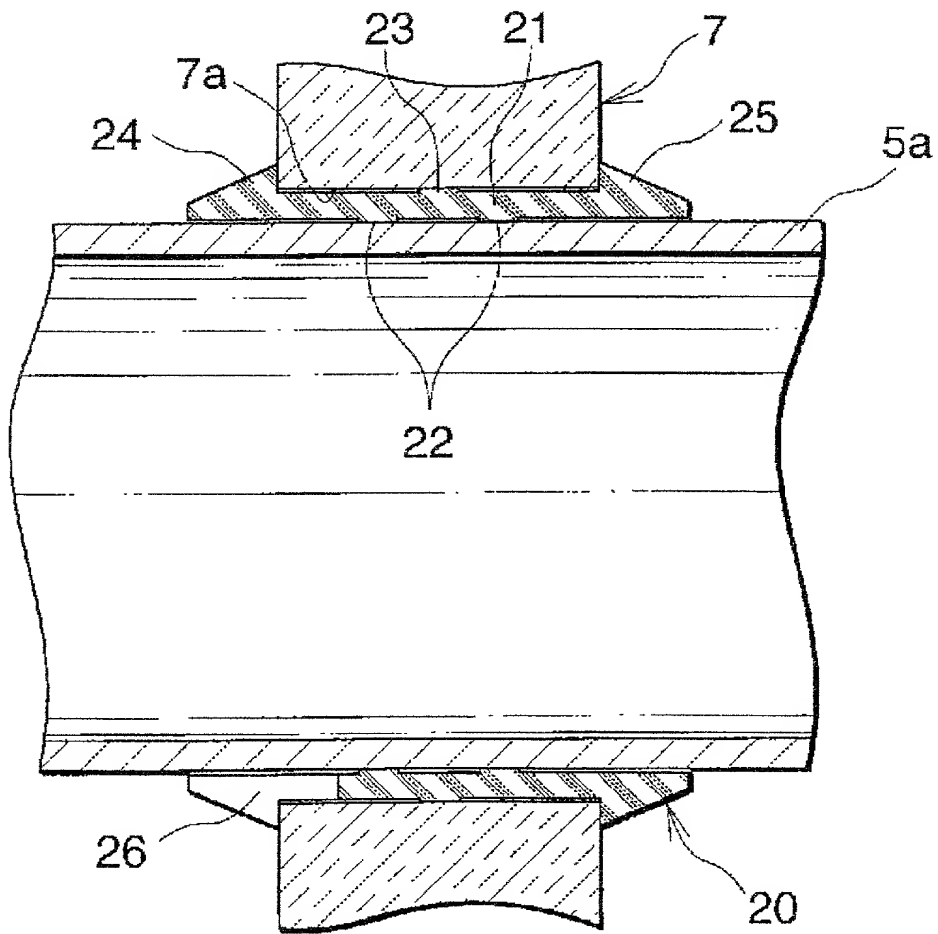
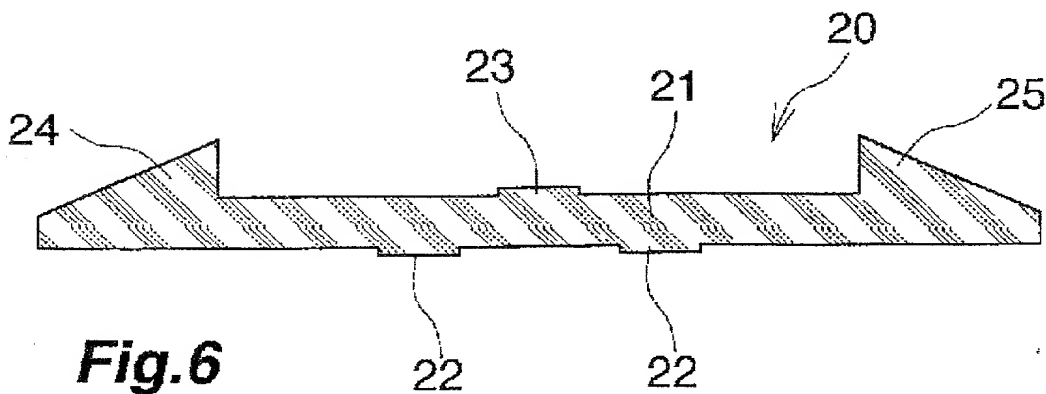


Fig. 3



**Fig.5****Fig.6**

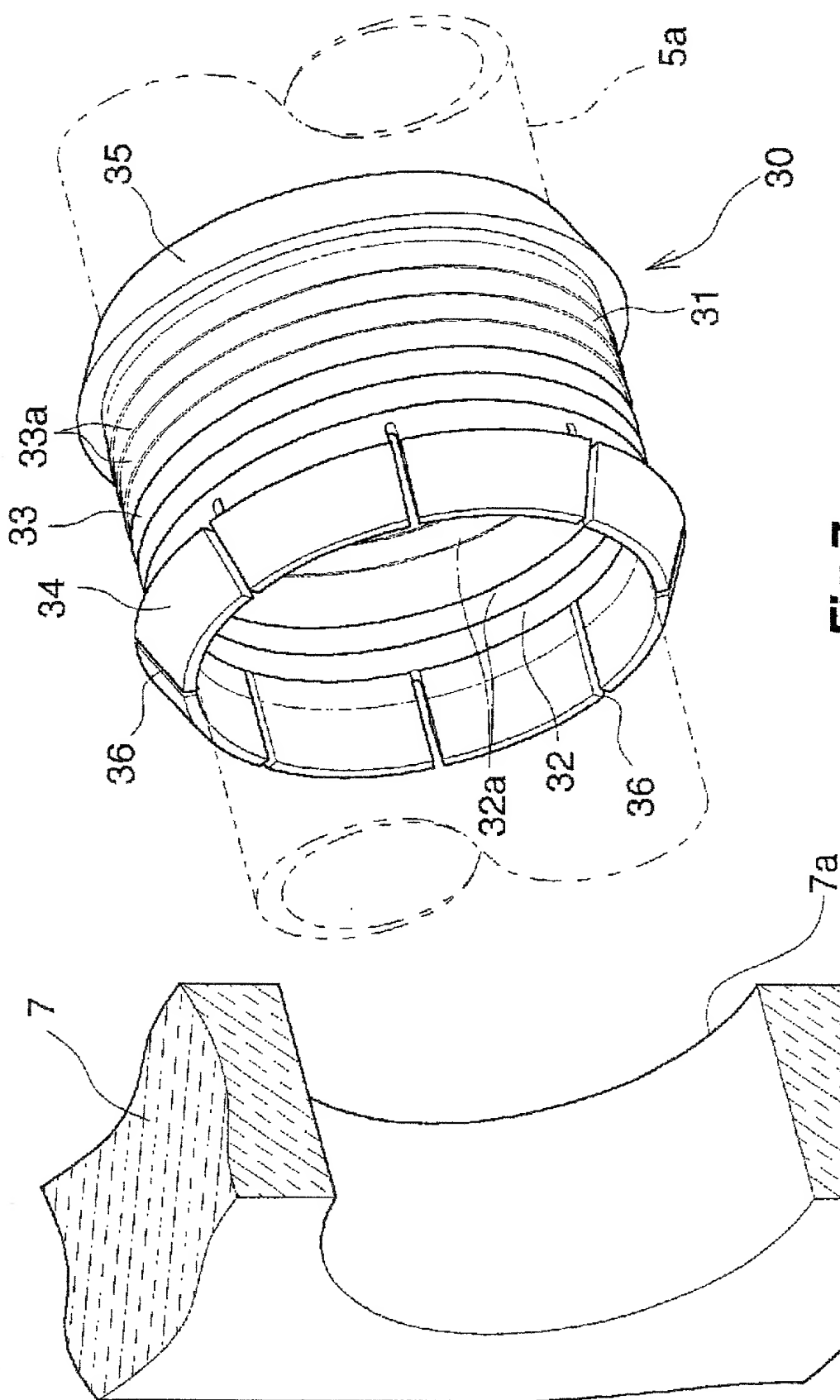
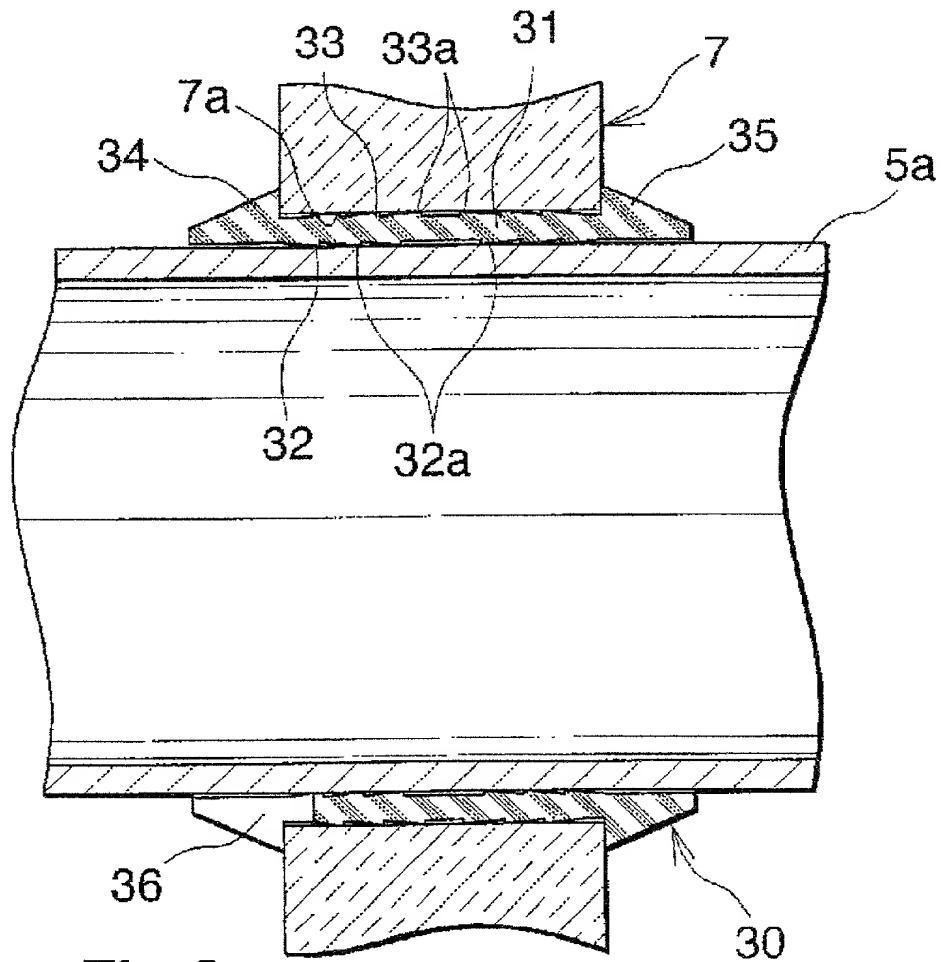
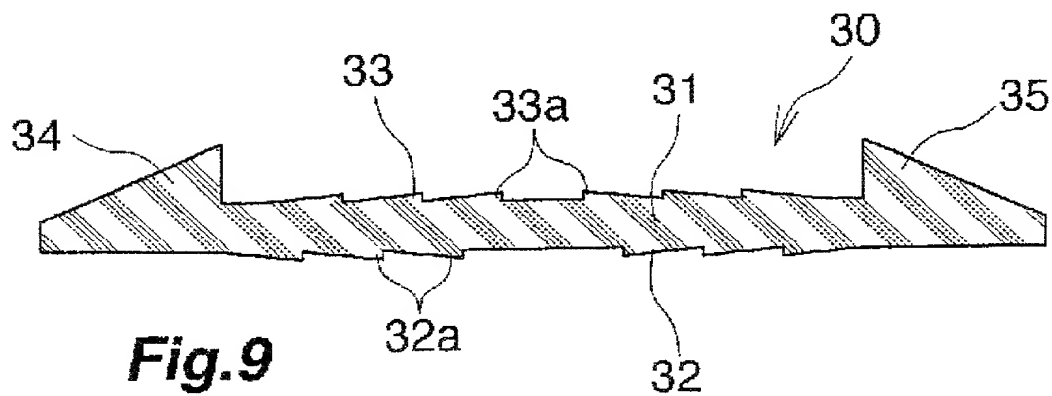
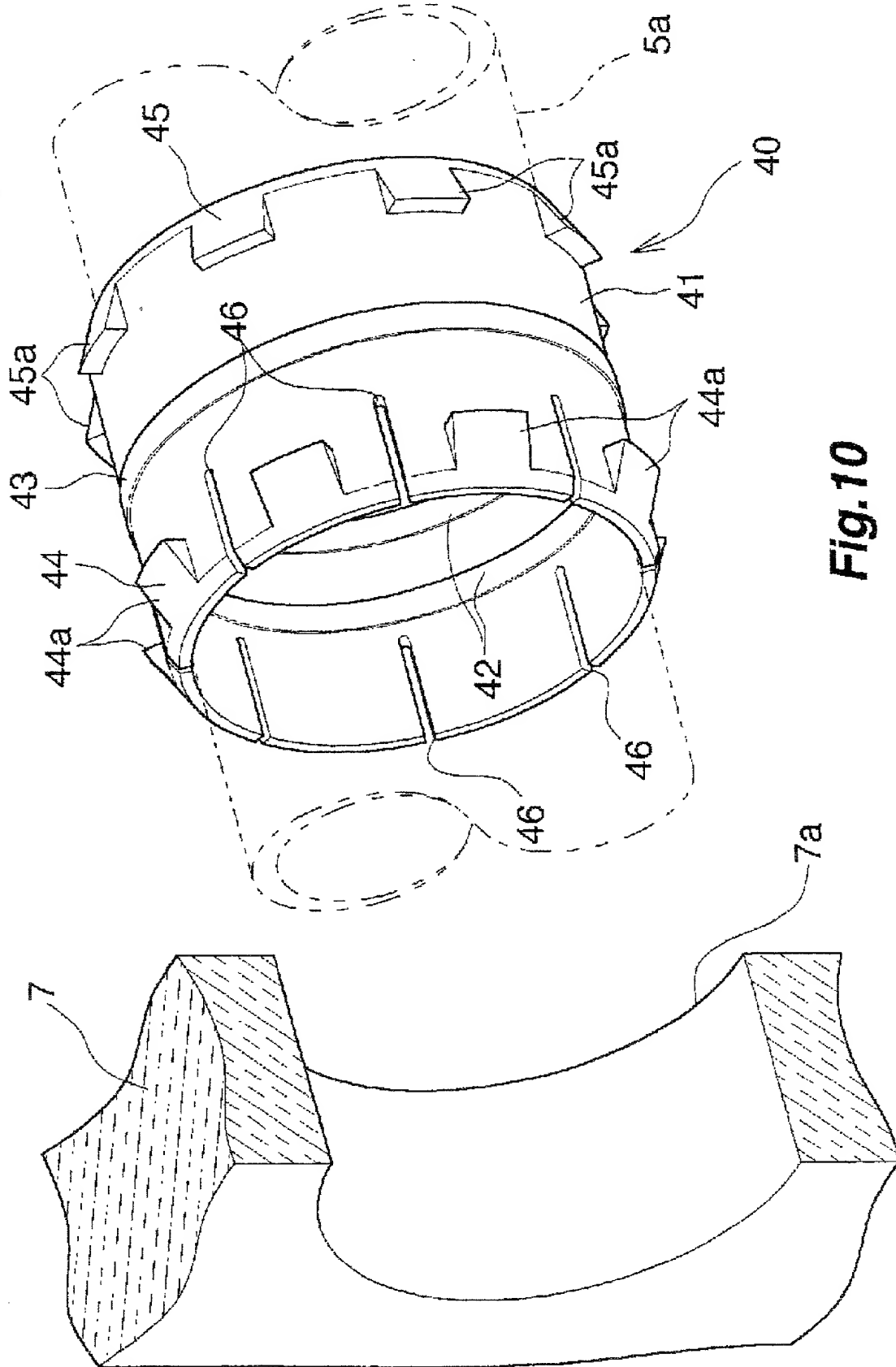
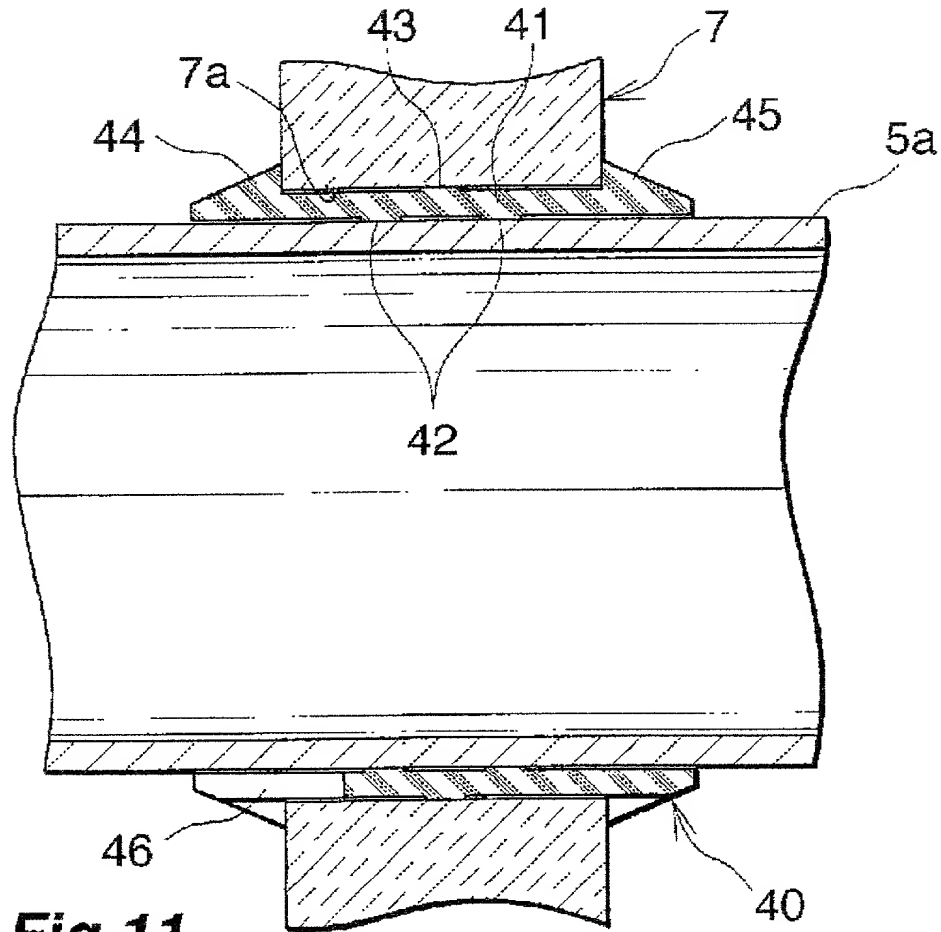
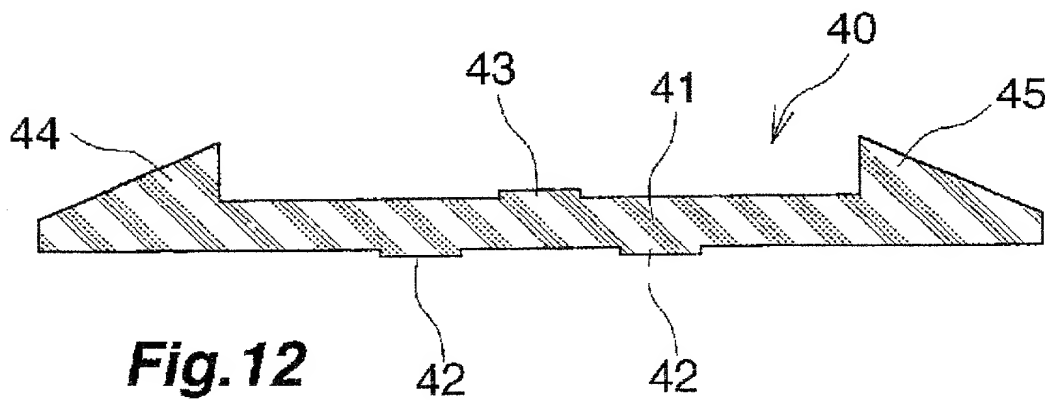


Fig. 7

**Fig. 8****Fig. 9**



**Fig. 11****Fig. 12**

MAR 15 2002

Declaration for U.S. Patent Application

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention **entitled**
SEALING BUSH FOR TUBE INSERTED THROUGH PARTITION AND MULTI-FLASH EVAPORATOR

INCORPORATING SAME

the specification of which is attached hereto unless the following is checked

☒ X

was filed on November 16, 2001 as United States Application Number 09/926,540 and filed
 on May 17, 2000 as PCT International Application Number PCT/JP00/03172 and was amended
 on May 2, 2001 (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 (a) - (d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application for which priority is claimed:

	<u>11-136600</u>	<u>Japan</u>	<u>18/5/99</u>	Priority Claimed
(List prior foreign applications. See note A on back of this page)	(Number)	(Country)	(Day/Month/Year Filed)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
	(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
	(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No

(See note B on back of this page) ☐ See attached list for additional prior foreign applications

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

(List Prior U.S. Applications)	(Appln. Serial No.)	(Filing Date)	(Status: Patented, Pending, Abandoned)
	(Appln. Serial No.)	(Filing Date)	(Status: Patented, Pending, Abandoned)
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I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:



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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18 of the United States Code, § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(See note C
above)

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NOTES

- A. Please list all foreign applications relating to the invention and check block "yes" or "no".
- B. If more than 4 prior foreign applications, please check this box and attach a sheet listing the remaining prior foreign applications.
- C. For residence in the U.S., indicate city and state, for residence outside the U.S., indicate city and country. The "Post Office Address" must be an address acceptable by a Post Office for delivery of mail.